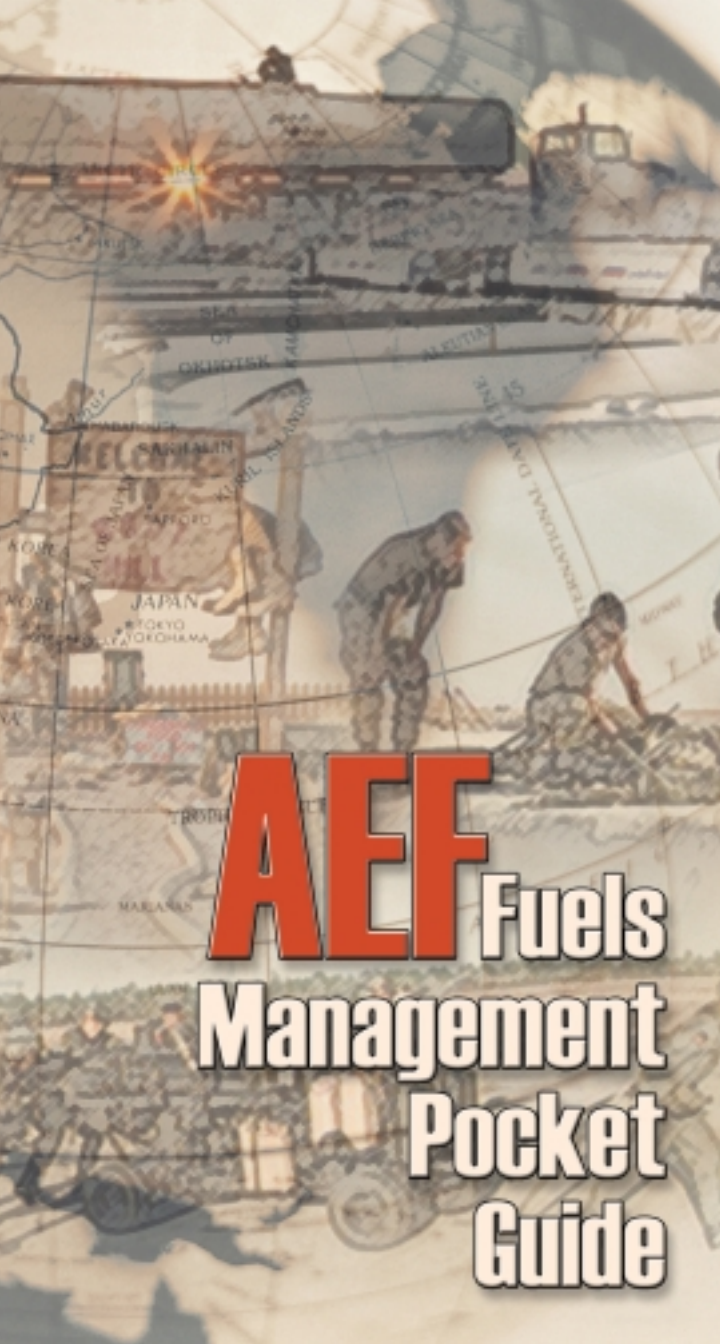
AEF
Fuels
Management
Pocket
Guide

Foreword

This pamphlet is intended for information use only.

By no means is this document to be used to conduct any war-time planning. Although much of the information contained in this guide is derived from publications used in warplanning, it does not take the place of such publications.

All questions concerning this guide should be directed to:

Air Force Logistics Management Agency
501 Ward Street
Maxwell AFB, Gunter Annex, Alabama
36114-3236
DSN: 596-4165 FAX 596-4167
E-mail:
robert.mcgonagle@maxwell.af.mil

Authors

Master Sergeant Robert McGonagle
Senior Master Sergeant Larry Ransburgh

Co-Authors

Captain Andrew Hunt
Major Brian Trigg

Editors

Beth F. Scott
Lieutenant Colonel Craig Rainey
Captain Andrew W. Hunt

Graphics and Layout

Captain Jennifer Manship
Lieutenant Colonel Craig Rainey
Master Sergeant Robert McGonagle

Special thanks to the men and women of POL who are the very best at what they do.

Table of Contents

A Snapshot in Time

This pocket guide is designed to assist in understanding fuels issues as they relate to aerospace expeditionary force (AEF) operations. The information is intended to provide a broad overview of many issues and be useful to anyone who has an interest in the Air Force fuels business. As the AEF continues to evolve, implementation and execution will also change. Therefore, this book should be used only as a reference; Department of Defense (DoD) and Air Force directives will always take precedence.

In the Beginning

When we think of war, many times, we envision large armies moving across the field, inspired by a clash of political ideologies. The intriguing twists and intricate strategy and battlefield tactics hold our attention above all other aspects of war. Yet, the bulk of a commander's considerations involve the logistical limitations that drive changes in strategy and tactics in order to keep forces supplied and moving. The provision of supplies has always been essential for military operations. Even in the earliest days of war, transportation of supplies and materiel relied on some form of pack animal, principally horses, for resupply. The horse's need for fodder (fuel) dictated to the commander the terrain and season of year through which he could campaign. However, fodder for horses proved to be a difficult challenge in sustaining forces. A premechanized army could contain as many as 40,000 animals, requiring 800 acres of fodder per day. Horses were imperative in a campaign, yet their subsistence greatly strained an army's resources. The need to keep moving in search of fodder tended to cause an army to move too fast.

After World War I, new modes of warfare made the use of pack animals obsolete, and technology manifested in aircraft and mechanized vehicles created a requirement for a new type of fodder, petroleum, oil, and lubricants (POL). Commanders still had to consider logistics; however, POL dominated their strategy and tactics. Further, POL products accounted for the majority of supplies shipped into a theater during the war. Regardless of its modern connotation, POL's intrinsic equivalent throughout history has been fodder.

Since World War II, POL has become increasingly important in keeping armed forces going in the field. The last 50 years of technological advances have only optimized modes of transportation, not lessened the impact of fuel on strategy, tactics, and operations. While technological advances may reduce lift requirements in the amount of support equipment or munitions required for operations, a similar advance seems unlikely for fuel. Arguably, fuel will remain the dominant logistics factor that limits strategic and tactical planning, as well as actual operations for the foreseeable future.

Fuels Planning

The criticality and importance of fuels planning and support cannot be overemphasized. The success of any campaign hinges on a well-constructed and carefully thought-out plan. The role of fuels logistics in an AEF is no different. If we are well prepared going into a contingency, it is less likely that we will experience problems during operations.

Today's war-planning tactics have evolved considerably from those of the past. However, the ultimate objective remains unchanged: *successfully accomplishing the mission*. As with all logistics functions, planning for fuels support must be carefully calculated and deliberately planned. A typical fuels-planning cycle has four phases:

- Preplanning phase: determine requirements and draft initial support proposal.
- Site survey phase: verify the feasibility to support the proposal.

- Actual plan execution.
- After-action planning: analyze operation for lessons learned.

Many tasks go into planning a contingency operation, and fuel is one item that must not be underestimated. Fuels management personnel are generally trained in all aspects of fuels operations. Those involved in exercise or contingency planning should also have a working knowledge of tactical and mobile fuel systems. Fuels planning should focus on providing standardized refueling support in a nonstandard environment, while understanding that some aspects of the job will require work outside the normal chain of operations. Many times, a short-notice deployment will require the senior fuels person to arrange fuel support with host nation military or civilian authorities to meet operational needs. This makes it essential that a fuels planner be involved in all aspects of contingency planning.

A common oversight to planning a deployment is the placement of the fuels personnel in the later chocks. Remember, aircraft without fuels support are just static displays! Ensure the fuels personnel are on the earliest chock.

Under the warm base, fixed-base concept of an AEF, much of the infrastructure should be in place and the planning accomplished. As such, many of the capabilities will be known and will have been taken into account. However, mission configuration changes of AEFs and air expeditionary wings will alter fuel and equipment requirements. In some cases, changes in host nation agreements or changes in suppliers will significantly alter the ability to provide fuel support. This inevitable change necessitates that

we briefly discuss some considerations that are critical to ensuring fuels support.

What's Required

Once the deployment location has been identified, the next step is to determine how much fuel will be required and what capability for fuel support exists at the deployment location. Normally, flying requirements are stated in numbers of sorties flown each day or as a sortie rate. To calculate the number of sorties in a single day, multiply the number of aircraft available times the sortie rate. Add the number of sorties to be flown each day to the fuel onload quantity. Occasionally, planners will provide the fuel onload per aircraft. If this is the case, the daily fuel requirement can be computed by multiplying the number of sorties times the onload per sortie. If operations planners provide only the planned average duration of a sortie, then a reasonably accurate onload requirement forecast can be obtained by using average consumption rates, multiplied by the sortie duration in hours. The average consumption rates for a variety of aircraft are provided at the end of this book. Limitations in capabilities at the deployment location can severely restrict the number of sorties. Knowing your capabilities up front will allow more accurate mission planning.

What's Available

Another essential consideration is determining what infrastructure, if any, exists at the deployment location and what modifications and equipment are required to meet requirements. In determining

what support or infrastructure is already in place, there are several sources of information available.

Major Command (MAJCOM)

The responsible MAJCOM should always be the first source for fuels information. Many MAJCOM fuels offices have unpublished trip reports, site surveys, and lessons-learned databases that contain helpful information from previous visits. Many provide detailed information on sources of supply and infrastructure locations within their theater.

Logistics Plans

Logistics plans offices are another source for information. They maintain the base war support plan that contains a fuels annex. In most cases, the host base will also maintain information on each bare-base location that falls under its jurisdiction.

Automated Air Facilities Information Files (AAFIF)

The Defense Mapping Agency prepares these files, which are available on the Global Command and Control System or on the Secret Internet Protocol Router Network linked to the command intel page. AAFIF files provide the best available information on non-USAF, especially non-DoD, installations worldwide. Information is not currently available for continental United States (CONUS) airfields. This information should be used with caution because it is not always accurate or current.

The Defense Logistics Agency (DLA) Defense Energy Support Center (DESC)

DESC has an abundance of information, with offices all over the world. DESC prepares the Bulk Storage

Facilities Report (RCS: DD-A&T[A]506) annually and provides a database for analyzing fuel storage capabilities worldwide in support of peacetime and contingency missions. The 506 report lists fuel tank information (type, capacity, status) for locations where US military fuel storage exists. The report contains information on receiving rates and modes. DESC also develops emergency distribution plans (EDP) to support contingency requirements. EDPs are designed to provide a source of logistics support in supplying fuel to bases during crises.

DoD Flight Information Publication (FLIP)

Also known as en route supplements, the FLIP is published by the Defense Mapping Agency. These books are available for worldwide regions, can be found at base operations flight-planning facilities, and are updated monthly. Listings are by airport name (for example, Hartsfield), as opposed to city name. They give pertinent airfield information, including a summary of fuel types available, contract refueling support, and availability of liquid oxygen (LOX) and demineralized water. The files do not show quantities available or dispensing rate.

Air Mobility Command (AMC) Assault Zone Survey Repository

This is a computerized FAX-on-demand system that contains detailed site surveys for hundreds of airports worldwide. For access to the system, call DSN: 576-5565 or commercial: (618) 256-5565.

These sources provide vital information on fuels availability and capability and are important for

ensuring adequate fuel and equipment supplies are available to support operations. The sources must be contacted to prevent missing valuable information. It is far better to ask before deploying than to suffer the consequences of not knowing upon arrival.

Fuel Grades Available

Aviation Fuel

No fuels-planning process is complete without determining what grades of fuel are available at a deployed location. Where aviation fuel is concerned, many locations do not have the Air Force-preferred grade of JP-8, so alternate fuels must be used. Alternate fuels include JP-4, JP-5, Jet A, Jet A-1 and Jet B. Special caution must be taken when working with JP-4 and Jet B as these are highly volatile fuels. Alternate fuels are those authorized for continuous use without impacting aircraft performance. However, alternate fuels, particularly commercial grades, may not contain additives. Long-term operation of some aircraft without additives may decrease engine life by increasing component wear. The Air Force has the capability to inject additives to minimize this impact. Many times DESC is successful in getting the supplier to inject the additives prior to shipment, making it ready for use when it arrives on site. If the supplier does not inject additives, the fuel must be inoculated by Air Force fuels personnel on location. The Air Force has recently developed fuel injectors specifically designed for use in forward operating locations or locations where no commercial injection system is in place.

The injector is powered by the fuel flow through the injector turbine and requires no outside power source. If the injector is not available, additives must be manually blended into the fuel.

Ground Fuels

Ground products (mogas [motor gasoline], diesel) are every bit as important to a campaign as aviation fuel. In most cases, ground fuels will be required before aircraft arrival to support communications and ground power equipment. Obtaining a suitable grade of ground fuel may not be a problem, but the quantity required can be. Ground fuel is more readily available but is in greater demand in the commercial sector. This increased competition for ground fuels with host nation needs can limit product availability. When calculating ground fuels requirements, an experienced fuels planner can provide a very accurate figure. Requirements are determined by contacting using agencies, such as civil engineers, transportation, communications, and aircraft maintenance. Receipt, storage, and issue procedures are basically the same as for aviation fuels, except that smaller dispensing systems are normally required. Most fuels organizations maintain kits containing smaller adapters for ground fuels operations, but special attention should be given to ensure there are small nozzles for use with vehicles that use unleaded fuel.

Cryogenics

Future AEF operations will see nearly all cryogenics products purchased locally because of their availability. However, the Air Force maintains

several different sizes of deployable production plants to support requirements where a commercial product is unavailable or proper quality cannot be maintained. Mobile cryogenics production plants are transportable via air, land, or sea and are driven by a diesel engine. Where smaller quantities are required, cryogenics products can be shipped in 400-gallon, skid-mounted containers. These containers are equipped with an overboard vent to allow shipment by air. Important considerations when planning for cryogenics support are product requirements, tankage required to support the requirement, and sufficient product availability via local purchase. DoD specifications for cryogenics are more stringent than most commercial specifications. Commercial products must meet the required specifications. An unlimited supply of product is of little use if it does not meet Air Force specifications.

Figure 1. Cryogenic filling operation

	Liquid Oxygen	Liquid Nitrogen
Boiling Point	-297°F	-320°F
Freezing Point	-361°F	-346°F
Liquid Density	9.52 lb/gl	6.74 lb/gl
Purity (by vol)	99.5% min	99.5% min

Table 1. Cryogenic Characteristics

Resupply

The fastest and most economical method of obtaining refueling support is to obtain support from the host nation airfield. Host nation support is especially critical during contingencies when logistics support from US units or equipment may not be readily available. Many times the host can provide some support and will allow limited use of its facilities. Arranging for fuel support, particularly with a foreign government, may require writing a memorandum of agreement or memorandum of understanding between the Government and the host. However, only certain agencies have the authority to enter into such agreements. The DESC is the primary agent that performs this function for fuel support but can delegate this authority.

In situations where Air Force personnel perform fuels operations and it becomes necessary to obtain fuel from a bulk source, the simplest and most expedient method of resupply is to use the same source of supply as the host airfield through arrangements with the supplier or host nation personnel. This method is the most common, and

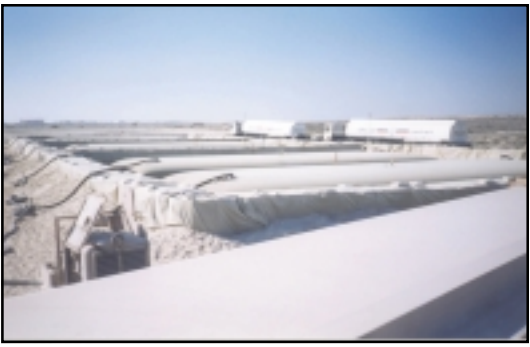

Figure 2. Receipt area

usually, deliveries are made using tank trucks. In some situations where there is an established US presence, a pipeline may be the method of resupply. However, there are situations where resupply is inadequate or not available. In these situations, there are several other sources of resupply.

Ocean Tanker

If there is a port available, DESC's Commodity Business Unit (CBU) can arrange for tanker shipments of fuel if given enough lead time. Tankers may also be diverted depending on location, timing, and urgency of the requirement. Contracts for ocean tankers are accomplished through the Military Traffic Management Command (MTMC), which has transportation contracting authority. Military Sealift Command ocean tankers also provide the capability to ship about 10 million gallons of fuel at a time, making them highly desirable where large quantities are required. DESC successfully shipped about 39.4 million barrels of fuel by tanker in 1998. Table 2

provides draft, capacity, and discharge rates of the most common ocean tankers.

Aerial Bulk Fuel Delivery System (ABFDS)

The ABFDS is designed for aerial delivery of fuel to locations where other methods of transportation are impractical. It has been particularly successful

Tanker Design	Draft (Loaded)	Capacity (bbl)	Offload (bbl/hr)
AO-22 USN	32' – 0"	138,000	8,000
AOE-1 USN	38' – 0"	166,000	42,700
T5S-RM2a	36' – 1"	180,000	24,800
Victory Class	39' – 10"	372,000	21,130
T10S-101b	70' – 2"	1,655,000	102,400

Table 2. Ocean Tanker Information

Figure 3. Ocean Tanker

delivering fuel to forward locations under austere conditions. The system has been qualified for bulk transport of all types of liquid fuel, including special fuels, such as JPTS (thermally stable jet fuel). The system can carry from 3,000 to 24,000 gallons per sortie, but *it is not a cost-effective or efficient means of providing fuel resupply*,

Figure 4. ABFDS Kit

especially in support of large flying operations. Depending on the contingency location and its distance from a fuel source, the aircraft may consume more fuel than actually delivered by the system. Limited availability of airlift during contingencies further complicates resupply by ABFDS. Use of aircraft as the primary mode of fuel resupply is permitted only after all other possible means of support have been exhausted.

Tanker Aircraft

All AMC aircraft can be used for on-ground defueling or wet-wing defueling and plane-to-

plane refueling using the aircraft's transfer pumps, an adequate length of discharge (collapsible) hose, and a single-point nozzle. Normally, the receiver will provide the nozzle and hose. These cargo aircraft are interoperable with all rotary-wing aircraft (except Army and Marine Corps UH-1 and OH-68), Marine Corps and Navy ground systems, and Army HEMMET M970 aviation road tankers. *This method should not be considered a standard method of resupply*; however, it can be used to provide small quantities of fuel under emergency conditions.

Fuel Storage

In any fuels operation, mission success cannot be achieved if adequate storage is not available. Established locations may have permanently installed storage systems that provide sufficient capacity to carry out any operation within the airfield's capability. However, where fuel infrastructure is inadequate or when operating in forward or austere locations, bladder systems, railroad tank cars, or any container that meets operational, safety, and environmental needs can meet storage requirements. It is important to maximize use of host storage facilities and minimize the construction of berms or use of bladders. The most common sizes of fuel bladders are 10,000 and 50,000 gallons. There are some larger bladders being used, but they are not as common. Bladders provide an efficient short-term storage capability, but because of their limited shelf life, a long-term solution should be sought where extended operations are expected.

Inventory Management Plan (IMP)

The Inventory Management Plan is a DoD integrated plan that details bulk-fuel inventory

Figure 5. 1.8 Million Gallon Storage Tank

levels and storage requirements. The IMP is designed to ensure DoD resources are efficiently used and provide financial management data. It is the culmination of a major effort of a partnership between the unified commands, Services, and Defense Energy Support Center to maintain a cost-effective and mission ready, bulk-petroleum storage operation. Also, the data contained within the IMP represent a coordinated effort between DESC, the unified commands, and the Joint Chiefs of Staff (JCS) and is based on individual terminal data, peacetime operations, and operating plan stockage requirements as authorized by JCS.

Defense Energy Support Center

DESC is critical to linking bulk-fuels stocks with contingency and warfighter support. Its origin extends back to World War II where it was an entity of the Department of Interior as the Army-Navy Petroleum Board. Over the years, DESC has gone through many changes, both in mission and in name. Its mission today is to build an energy program aimed at managing energy products. DESC is a large organization with many different units. However, an overview is made of those areas that are of particular interest when deploying or preparing to deploy in an expeditionary environment.

Direct Delivery Fuels Commodity Business Unit

The Direct Delivery Fuels Commodity Business Unit is the worldwide acquisition and integrated materiel manager for motor gasoline, gasohol, diesel fuels, jet fuels, and kerosene delivered directly to using activities by contracted vendors to support the Services. It also oversees the Post, Camp, and Station program (used primarily to procure commercial ground products). Its specialty fuels division handles commercial aviation fuels delivered in aircraft at commercial airports worldwide. It also directs implementation of Federal, DoD, and DLA energy contracting regulations and programs, including contracting policies. It maintains the fuels procurement system and contract oversight plan.

It is also responsible for the Aviation Into-plane Reimbursement (AIR) Card and DoD Fleet Credit Card programs. The AIR Card program allows

government aircrews to present their AIR Cards at DESC into-plane contract locations to obtain fuel. The AIR Card simplifies billing and procedures for fuel purchases and is used to simplify payments for local purchases of ground services at contract locations. It also provides wing commanders visibility into their flying-hour program and helps DESC identify future contract locations to maintain further possible program savings.

The DoD Fleet Credit Card program is a new program available for drivers of DoD vehicles (cars, trucks, tanks, and so forth) and allows drivers to purchase fuel with a swipe of their card. The process is electronic and paperless, with billing data being sent electronically to the Defense Finance Accounting Service.

The Bulk Fuels CBU

The Bulk Fuels CBU is responsible for the purchase, distribution, inventory management, and overall quality of bulk fuels and lubricants used by DoD worldwide. Bulk fuels are purchased in accordance with applicable military specifications. Products include aviation fuels, marine fuels, qualified lubricating oils, and fuel additives. Bulk fuels are generally purchased directly from the point of manufacture and are transported by pipeline, ocean tanker, barge, truck, and rail. A fleet of six ocean-going tankers is currently dedicated to delivering bulk fuels worldwide. DESC owns the product from the point of purchase and is responsible for managing the distribution and storage of these fuels until ultimate sale and consumption by the customers. The Bulk Fuels CBU writes annual contracts with

75 percent, minimum-lift guarantees. It also writes 2- to 3-year *requirements* contracts.

The terms of providing fuel in support of operations depend on location. If the operation will be conducted at an overseas base, it is probably supported through the bulk fuel program. If there is no base or US Government-controlled storage but a commercial airport is available for operations, DESC may or may not have an into-plane contract already available. If there is no contract available, the Direct Delivery CBU will write one with a valid requirement. *The direct delivery team is very responsive and generally can get something in place within 48 hours.*

The Bulk Fuels CBU has a core fleet of six 235,000-barrel (9.8 million-gallon) ocean tankers for fuel distribution. It spot-charters tankers and is responsible for funding (about $32M annually) three afloat-prepositioning force (APF) tankers. These ships hold from 175,000 to 308,000 barrels of war reserve jet fuel (JP-5). Two of the three ships have offshore petroleum discharge systems. The APF tankers are essentially floating storage, and while DESC funds the vessels and owns the inventory, the Commander in Chief, Pacific Command controls their movements.

Unlike the APF tankers, the Marine Corps funds the 13-vehicle cargo ships under the Maritime Prepositioning Ship program. To support the on-board equipment, each ship holds 30,000 barrels of DESC-owned JP-5 war reserve fuel, and some of the ships also hold 4,000 barrels of gasoline (also DESC-owned).

The Army stores small quantities of JP-8 war reserve fuel in HEMMTS on board Army roll-on/

roll-off ships. It currently has three ships for a grand total of 6,000 barrels of fuel.

DESC has seven field offices located globally:

- *Defense Energy Region Europe (DER- E) Balkans Operations*
- *Defense Energy Region Middle East (DER- ME)*
- *Defense Energy Region Pacific (DER- PAC)*
- *Defense Energy Office Korea (DEO- K)*
- *Defense Energy Office Alaska (DEO-A)*
- *Defense Energy Office Japan (DEO- J)*
- *Defense Energy Office Middle Pacific (DEO-MP)*

Facilities and Distribution Unit

The Facilities and Distribution Unit provides inventory accounting at worldwide storage locations and writes international agreements. It also provides support to foreign military sales agreements. To get the right quantities of fuel, at the right place, at the right time, it uses the Inventory Management Plan. Facilities and distribution personnel manage worldwide fuel terminal operations as well as storage and acquisition programs. It programs for operations and maintenance of Government-owned, contractor-operated, and contractor-owned and operated facilities. It manages real property maintenance activity and military construction projects. Environmental protection specialists are responsible for ensuring prevention, control, and abatement of environmental pollution at DoD fuel facilities. Contracting specialists and officers purchase services required for storing bulk-petroleum products as well as services required for

other areas of fuel operations, including environmental protection and aircraft refueling. Supply system analysts continually review planned inventory levels and programmed operation of fuel facilities to ensure optimal utilization of resources. Transportation management specialists continually review the distribution infrastructure to ensure optimal utilization of transportation resources such as pipeline tenders and guaranteed traffic programs.

The Ships Bunker Fuel Program provides various grades of ship propulsion fuels for combatant ships, Coast Guard vessels, and various classes of US Government-owned and chartered ships at commercial ports worldwide. Bunker contracts are in place servicing customers at 91 ports domestically and 85 ports overseas.

The DESC tailors its business operations to provide the best customer support possible in purchasing bulk-refined petroleum products, coal, natural gas, synthetic fuels, and electricity for the Services and more than 4,000 Federal civilian agencies around the world.

Personnel and Equipment Requirements

MAJCOMs are responsible for determining and coordinating all personnel and equipment requirements. There is no exact formula for determining the number of people or equipment needed; historical data and personal experience will normally aid in the planning. A deployment requirement chart is a handy guideline for estimating personnel and equipment requirements.

Special consideration should be given to ensure personnel with the required special experience identifiers (SEI) and correct types of equipment are sourced. Additionally, equipment requirements should include nonrefueling vehicles needed in the fuels operation.

Civil Engineers

When operating out of an established base or airport, fixed-fuel facilities will probably be under operational control of the host airport and not the responsibility of Air Force engineers. However, in a bare-base environment, civil engineers maintain normal responsibilities of liquid fuels maintenance. They do site preparation, including construction of berms, and provide other environmental protection measures. They provide emergency power if necessary and maintain fuel-dispensing system filters. Unless provided by the host location, civil engineers retain responsibility for providing these services. Civil engineers are one of the most important groups in establishing a forward-deployed fuel system. The success of the refueling mission hinges on the availability of civil engineers to help prepare the surface for fuel bladders. Full sortie generation cannot be achieved unless bladders are erected and operational. Therefore, it is essential that this be accomplished in the earliest stages of deployment.

Transportation

The transportation function provides vehicle maintenance for special purpose, general purpose, fuels mobility support equipment (excluding bladders, seal drums, and additive injectors), and forward air refueling point (FARP) equipment. It

accomplishes meter calibrations, filter-separator element changes, hydrostatic hose testing, and other maintenance actions. It is responsible for ordering and installing fuel couplers, connections, nozzles, strainers, decals, and related items. It assists in fuels preventive maintenance inspections and maintains refueling equipment filter separator elements. In an AEF environment, it will be critically important that a trained transportation specialist be available during deployments to keep fuels equipment running. This has been a recurring problem in deployments.

Prepositioned Equipment

Fuels mobility support equipment is strategically positioned in many parts of the world. Active duty Air Force, civilians, and contractors maintain the equipment. There is a variety of equipment used in deployment operations. The most common are listed with basic information on each to provide an overview of the equipment. Rarely will you find all this equipment at all locations.

R-14 Air Transportable Hydrant Refueling System (ATHRS)

By far, the most widely used and one of the most versatile systems is the R-14. The R-14 is a portable, hydrant-refueling system that can be airlifted or ground shipped anywhere in the world and made fully operational in a matter of hours. A complete system contains three identical, self-sufficient modules. Each module consists of a pumping unit; two 50,000-gallon bladder tanks; and all the hoses, valves, and fittings necessary for operation. The pumping module is configured on a four-wheeled

Figure 6. R-14

trailer and features the same components found on conventional servicing equipment. Each R-14 module can fuel one heavy aircraft at 600 gpm or two fighter aircraft at 200 gpm.

R-22 Trailer-Mounted Transfer Pump

The R-22 is generally used to push fuel from a bulk storage system, tank truck, or tanker aircraft to ATHRS bladder tanks. It is often used in conjunction with the R-14 system. The R-22 can also be used with a hosecart or skid-mounted filter separator to deliver fuel directly to aircraft. It has an 85 HP gasoline engine that can deliver fuel through the line at up to 900 gpm. The newer models have a pumping capability of only 600 gpm.

Figure 7. R-22 Site Setup

FFU-15E Skid-Mounted Filter Separator

The FFU-15E is a skid-mounted filter separator designed to filter particles and separate water from

Figure 8. FFU-15E Fuel Filtering Unit

fuel. It can filter jet fuels at 600 gpm, diesel at 450 gpm, and gasoline at 750 gpm. The FFU-15E can be configured for use with many different systems to provide clean, dry fuel. The FFU-15E can also be used with other Services' equipment to provide increased flexibility in fuels operations. The FFU-15E weighs 785 pounds.

PMU-27 Pumping Unit

The PMU-27 is a trailer-mounted, engine-powered unit consisting of a 50-gpm pump, filter separator, meter, hoses, connections, and nozzles. It is designed to support servicing of small aircraft and transfer of small quantities of fuel. It also is capable of defueling four 55-gallon drums simultaneously, pumping from an external source and defueling aircraft auxiliary tanks. The unit is also an effective ground fuels dispensing unit.

Aerial Bulk Fuel Delivery System

The ABFDS is an aerial, fuel-delivery system that enables aircraft to rapidly transport fuel to locations close to or behind enemy lines. The

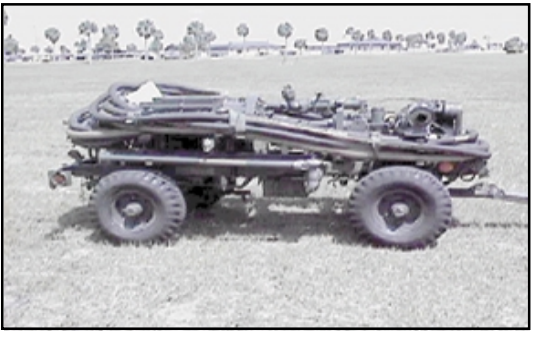

Figure 9. PMU-27 Pumping Unit

ABFDS consists of two 3,000-gallon aerial bladder tanks, two pumping modules, a meter, and hoses. It is typically installed in the C-130 aircraft but can also be installed in the C-141, C-5, and C-17. The tanks are mounted on a delivery platform and held

Figure 10. ABFDS Aircraft Configuration

securely by tiedown straps. A cross-over manifold connects the two pumping modules and allows filling or evacuation of both tanks by one module. The ABFDS is capable of delivering 600 gpm with one pump or 1,200 gpm using both pumps. It is an extremely versatile system that is capable of offloading fuel into trucks, bladders, and other containers.

The ABFDS can also be used with alternate capability equipment for filtration of aviation fuels, 500-gallon drum transport, wet-wing defueling, and aircraft-to-aircraft refueling.

Forward Area Refueling Point

Provides personnel and specialized equipment to establish and operate a forward area refueling point. Used primarily in quick-turn support of special operations aircraft, FARP provides a highly efficient way of transferring fuel from aircraft to aircraft in a nonstandard or hostile environment. FARP operations expand the role of Special Operation Forces around the world by providing a means of hot refueling from a tanker aircraft to various types of fixed- and rotor-wing receiver aircraft. Responsibility for the teams, equipment, and all FARP missions falls under the Air Force Special Operations Command at Hurlburt Field, Florida.

Figure 11. FARP Cart

Refueling Units

The vehicle fleet is the mainstay for fueling operations in an expeditionary air forces environment. It provides the greatest flexibility and mobility. There are many types of refueling units in use by the Air Force, but the most commonly

Figure 12. R-11 Kovatch Refueler

used in a deployed environment are the R-11, R-9, C-300, and C-301.

The R-11 is the most common and is the primary refueler for servicing aircraft. The R-11 has a 6,000-gallon fuel capacity with one 60-foot hard hose. It can refuel aircraft at rates of up to 600 gpm; it can also defuel aircraft and be used as a bulk-fuel hauler. The R-11 is designed for driving on improved roads and, on a limited basis, unimproved roads. Refueler road speed, fully loaded, is 60 MPH, depending

Figure 13. C-300 Ground Fuel Truck

on road and weather conditions. The R-9 is similar to the R-11, but its capacity is 5,000 gallons.

The C-300 is a 1,200-gallon unit used to service ground fuels. It is the primary vehicle used to refuel base support equipment and special purpose emergency equipment. It is well suited to make small, bulk-fuel deliveries to numerous small tanks. The C-301 is identical to the C-300 except that it is equipped with four-wheel drive to increase its maneuverability on unimproved surfaces.

Hose Carts

MH-2 series hose carts are trailer-mounted units designed for transfer of fuel between fixed-hydrant system outlets and single-point refueling aircraft receptacles. They are equipped with a filter separator, meter, flow control valve, and inlet/outlet hoses but do not have any pumping capability. Hose carts can also be used to provide filter/meter capability for filling refueling units from hydrant systems, for bare-base refueling using bladder storage and R-22 pumping systems, and as a substitute for the FFU-15 filter separator. Hose carts

Figure 14. MH-2 Hosecart

	MH-2B	MH-2C
Shipping Wt (lb)	1,700	1,760
Length (in)	119.0	138.0
Width (in)	68.0	70.0
Height (in)	80.5	80.0
Cubic Feet	377.0	448.0

Table 3. MH-2 Hosecart Information

use standardized single-point refueling nozzles; however, the hydrant quick-coupler valve (moose head) that connects onto the installed hydrant outlet on the aircraft ramp may differ. This is a concern when intending to use Air Force supplied hose carts on a host airfield. Use of a hose cart in conjunction with an R-22 pumping system requires removal of the hydrant quick-coupler valve and replacement with a 4-inch KAM-LOK coupler.

GRU-17E Aircraft Fuel Servicing Unit

The GRU-17E is a portable pantograph designed for refueling tactical aircraft during hot refueling operations (refueling aircraft with engine running or simultaneous weapons loading). It consists of four sections of pipe connected with swivel joints and mounted on casters. It is fully equipped with all components needed to operate the unit and only requires a fuel source for operation.

Cryogenics Tanks

The most common tanks used in a deployed environment are the TMU-24E LOX tank and the NRU-5E LIN tank. Both tanks are 400-gallon skid

mounted and can receive, store, and issue liquid oxygen or nitrogen products to service carts at bare-base locations or where other methods of transportation are impractical. The units are completely self-contained and weigh approximately 1,500 pounds. They are equipped with an overboard vent to facilitate transporting by air.

Collapsible Coated Fabric Tanks

Collapsible fuel tanks normally are provided in either 10,000- or 50,000-gallon capacity. They are constructed of single-ply, nylon fabric material with reinforced corners and impregnated with urethane or nitrile. The interior of the tank is coated with polyester. The 50,000-gallon tank weighs approximately 1,400 pounds; the 10,000-gallon tank weighs approximately 200 pounds. Dimensions of an empty 50,000-gallon bladder are 24 feet by 65 feet. Dimensions of an empty 10,000-gallon bladder may be 12 feet by 42 feet or 22 feet by 22 feet. The tanks are tested to operate from -40° F to 160° F.

	10K	50K
Shipping Wt (lb)	225	1,500
Rolled Length (in)	104	136
Rolled Width (in)	31	40
Rolled Height (in)	32	40
Cubic Feet	60	126

Table 4. Coated Fuel Bladder Information

Seal Drums

Seal drums are collapsible, rubber, nonventer containers for transporting and storing fuel. They are available in 55- or 500-gallon capacities. They are constructed of four-ply tire cord and equipped with swivel plates and anchor shackles at both ends to allow tiedown aboard aircraft. They can be towed (rolled) on the ground using a special lifting and towing yoke. The internal tanks are equipped with fuel/defuel valves and are complete with external fuel-servicing adapters. Because drums are nonvented, they must be kept shaded to prevent fuel expansion and drum rupture. The drum becomes brittle below 20° F.

	55 Gal	500 Gal
Shipping Wt (lb)	27	305
Length (in)	37 – 38	72 – 89
Width (in)	24 – 33	36 – 48
Height (in)	6 – 24	9 - 48
Cubic Feet	63 full	93 full

Table 5. Seal Drum Information

Managing Risk AFI 91-213

Another important aspect of fuels operations in an AEF environment is safety planning and operational risk management. Careful planning in this area can prevent the accidental destruction or loss of aerospace forces. Everyone is responsible for making safety plans that promote mission objectives. Time, location, facilities,

environmental conditions, equipment, and mission urgency can make it necessary to accept certain hazards and risks. Consider all safety standards and programs during mission planning. Keep in mind, however, that certain missions may require acceptance of unavoidable risks to reach primary mission objectives. Prior to acceptance of any risk, ensure the decision to accept risk has been made at the appropriate level. The acceptance of hazards or risks under certain conditions does not mean they should be allowed to become operational norms. When full safety compliance cannot be made, practical measures must be applied to reduce or control the risk. When the need for noncompliance no longer exists, standard safety procedures must be reinstituted. When risks or hazards are accepted, all personnel involved should be completely informed of these conditions, why they exist, what adverse effects they potentially create, and how to best cope with them. The very

Figure 15. Landing Gear Collapse, F-16

nature of the fuels business requires strict attention to detail in safety planning. Poor planning or failure to adequately address safety issues can have disastrous effects on the mission.

Fuel Additives

Blending

The Air Force has recently developed a fuel injector specifically designed for use in a forward operating location or location where no commercial in-line injection system is in place. This piece of equipment is called the Hammonds 4T-4A Fuel Additive Injector (NSN 4930-01-418-2694), manufactured by Hammonds Technical Services, Inc, Houston, Texas. This injector requires no outside power source and is powered by the fuel flow through the injector turbine.

In the event a Hammonds Injector is not available, additives must be manually blended into the fuel. Fuel system icing inhibitor (FSII) and corrosion inhibitor (CI) may be premixed prior to adding to fuel. A conductivity additive must be added to the fuel separately and must not be premixed with other additives. Additives may be introduced into refuelers using a funnel and hose with one end submerged below the surface of the fuel. Approximately 150 percent of the refueler capacity should then be circulated before issuing fuel. An alternate method is to add required quantities of additives to a refueler filled to not more than one-third capacity, then finish filling the unit. Fuel can then be issued without circulation (reference Technical Order [TO] 42B-1-1).

+100

Today's advanced aircraft need improved thermal stability in their jet fuel, and current special fuels, such as JP-7 and JPTS, are very expensive. The

Truck Fuel rqmt (lb)	Blending Fuel rqmt (gal)	FSII (gal)	Corrosion Inhibitor rqmt (gal
30,000	4,478	4.48	448
40,000	5,970	5.97	597
50,000	7,463	7.46	746
60,000	8,955	8.96	896
70,000	10,448	10.45	1,045
80,000	11,940	11.94	1,194
90,000	13,433	13.43	1,343
100,000	14,925	14.94	1,494
110,000	16,418	16.42	1,642
120,000	17,910	17.91	1,791
130,000	19,403	19.40	1,940
140,000	20,896	20.90	2,090
150,000	22,388	22.39	2,239

Table 6. Additive Blending Information

Wright Laboratory Aero Propulsion and Power Directorate developed JP8+100 to solve this economical problem, and the Air Force approved its use in May 1996.

The +100 additive contains a detergent, a dispersant to prevent fuel from gumming up on engine components, and a metal deactivator. It is designed to increase the thermal stability of jet fuel from 325° to 425° F, hence the suffix +100. Increased thermal stability will play a key role in future Air Force weapon systems. Highly thermal fuels like JP8+100 can be used as a *heat sink* to disperse heat from aircraft subsystems. JP8+100 also reduces coking on main burner fuel nozzles, afterburner manifolds, and feed tubes.

The downside to its benefits is that the +100 additive contains a surface-active agent that disarms coalescing filters in fuel systems, does not remove water from the fuel, and allows contaminated fuel to pass through the filter. To minimize this potential hazard, the additive is injected as close to the skin of the aircraft as practical. JP8+100 requires strict quality control measures to prevent filter disarming and possible aircraft contamination.

Fuel System Icing Inhibitor

FSII is diethylene glycol monomethyl ether. It is a compound that lowers the freezing point of water entrained in fuel, preventing the formation of ice that can clog filter elements and cause aircraft engine stalls. FSII does not lower the freezing point of the fuel, only the water in the fuel. Unlike commercial and most Navy aircraft, Air Force aircraft do not have fuel system heaters to prevent

moisture in the fuel from freezing. Water removes FSII from fuel, so introduction of water must be avoided. FSII is blended at a rate of 1 gallon of FSII per 1,000 gallons of fuel.

Corrosion Inhibitor

CI is a fuel additive that prevents corrosion of steel surfaces and provides lubricity to fuel pumps and controls. CI is blended at the rate of 65 ml CI per 1,000 gallons of fuel.

Figure 16. Hammonds 4-inch Injector

Static Dissipater Additive (SDA)

SDA aids in relaxing static charges and decreases the possibility of fires or explosions caused by static electricity. DuPont Stadis 450 is the only approved conductivity additive for use in Air Force aviation fuels. Conductivity additive is first diluted, one part additive to nine parts jet fuel. Generally, when CU values are from 0 to 50 CU, blend 31 ml per 1,000 gallons of fuel; and when

	DF-1	DF-2	DFM	MGX*
Density (lb/gl)	6.9	6.9	7.0	6.2
Flash Point °F	100	125	140	-30
Freeze Point °F	41	34	30	-75
API Gravity	-	33–42	-	47–71
NATO Symbol	F-54	F-54	F-76	F-46/49/50
*Represents all grades of motor gas; e.g., unleaded o premium.				

Table 7. Ground Fuel Characteristics

	JP-8	JP-5	Jet A-1	Jet B
Density (lb/gl)	6.7	6.8	6.7	6.4
Flash Point °F	100	140	100	-20
Freeze Point °F	-53	-51	-53	-58
API Gravity Range	37–51	36–48	37–51	45–57
NATO Symbol	F – 34	F – 44	F – 34	F - 18

Table 8. Jet Fuel Characteristics

between 50 to 100 CU, blend 19 ml per 1,000 gallons of fuel.

Aircraft Planning Factors

Table 9 is for contingency and exercise planning only, and quantities are based on averages. Actual consumption will vary due to mission profile. Normal load indicates the normal aircraft capacity, excluding ferry tanks. Official aircraft consumption factors are prescribed in Air Force

Instruction 65-503, *US Air Force Cost and Planning Factors.*

MDS	Name	Burn Rate (GPH)	Avg. Load (gl)
A-10	Thunderbolt	615	1,644
B-1B	Lance	3,544	30,842
B-2	Spirit	2,687	25,373
B-52H	Stratofortress	3,266	46,630
C-5	Galaxy	3,500	53,083
C-17	Globemaste	2,260	27,042
C-130	Hercules	800	6,662
F-15	Eagle	1,580	2,400
F-16	Falcon	800	1,072
F-117	Nighthawk	923	1,158
KC-10	Extender	2,650	52,000
KC-135	Stratolift	2,070	31,200
U-2	Dragon Lady	290	2,775

Table 9. Sample of Aircraft Burn Rates

Helpful Fuels Terms

ABFDS - Aerial Bulk Fuel Delivery System

Additive - agents used for improving existing characteristics or for imparting new characteristics to certain petroleum products (for example, fuel system icing inhibitor and corrosion inhibitor).

Advanced Echelon (ADVON) - an initial deployment element of personnel and equipment in a specific unit type code. The ADVON normally consists of equipment and personnel required to establish an austere operating capability of up to 7 days.

Alternate Capability Equipment (ACE) - hose and filter assembly allowing aircraft to be refueled directly from the ABFDS.

Alternate Fuel - fuel authorized for continuous use. The operating limits, thrust outputs, and thrust transients shall not be adversely affected. The applicable aircraft flight manual shall define limitations, if any, of a significant nature on aircraft performance parameters. The use of an alternate fuel may result in a change of maintenance or overhaul cost. Engine trim adjustments may be necessary or desirable to use an alternate fuel.

American Petroleum Institute Gravity - scale for measuring the density of liquid petroleum products. Gravity is important in determining product identification because it indicates which product is heavier in relation to another product.

Area Lab - laboratory that provides testing services on samples of petroleum products. They perform specification tests to determine the quality of products under procurement and in Air Force inventory.

Ash Content - the inorganic matter in combustible material. Determined by completely burning the substance and weighing the residue. This is important where fuel requirements demand minimum ash residue after combustion. The ideal fuel is one that burns and leaves no ash.

ASTM - American Society for Testing Materials.

ATHRS - air transportable hydrant refueling systems.

Auto Ignition - spontaneous ignition resulting in rapid reaction of the air-fuel mixture in an engine. The flame speed is many times greater than the normal ignition spark. In a reciprocating engine, the noise associated with auto ignition is called knock.

Automated Airfield Information File (AAFIF) - information database prepared by the Defense Mapping Agency that lists comprehensive airfield data. It includes fuel support capability at overseas military and civilian airfields.

AVFUELS - aviation fuels, both gasoline and turbine.

AVGAS - aviation gasoline for reciprocating engine aircraft.

Bare Base - a base that has a runway, taxiway, parking area, and source of water that can be made potable.

Bare-Base System - Air Force system consisting of Harvest Eagle, Harvest Bare, and fuels mobility support equipment (FMSE). Designed to provide minimum essential troop facilities and operational support.

Barrel (BBL) - standard unit of measurement of petroleum liquids, consisting of 42 US standard gallons at 60° F. A barrel is not a container. Usually confused with a drum.

Benzene - a colorless liquid hydrocarbon with six carbon atoms and six hydrogen atoms arranged in a hexagonal ring structure. Used as a component in high-octane gasoline.

Benzin - term used in some countries, meaning gasoline.

Black Cargo (dirty cargo) - general term used to describe liquid cargoes of crude or fuel oils.

BPD - barrels per day.

BTU - abbreviation for British Thermal Unit, amount of heat necessary to raise the temperature of 1 pound of water 1° F. In flying operations, it indicates the amount of heat energy that can be obtained from a given weight of fuel.

Bulk Petroleum Products - liquid petroleum products transported by various means and stored in tanks or containers having an individual fill capacity greater than 260 liters (69 gallons).

C-Day - the unnamed day on which a deployment operation commences or is to commence.

CI - corrosion inhibitor.

Class III - category of supplies including petroleum fuels, lubricants, compressed gases, chemicals, and so forth.

Classes of Fires - Class A, fire of ordinary combustibles, such as paper, wood, extinguishable by water; Class B, fire of flammable liquids like gasoline, oil, and grease and extinguished by smothering; Class C, fires involving electrical equipment and extinguished by nonconducting agents; Class D, fires involving burning metal.

Clean Cargo - aviation and motor gasoline, diesel oils, lubricating oils, jet fuels, and kerosene.

Cloud Point - the temperature at which paraffin or other solid substances begin to crystallize out or separate from solution, imparting a cloudy appearance to the oil, when oil is chilled under prescribed conditions. Important in arctic or polar operations. Wax crystals will plug fuel injectors and stop the engine.

Collocated Operating Base (COB) - active allied host nation base designated for joint use by US wartime augmentation forces or relocation in-place forces. COBs are **not** US bases.

Color - various types of petroleum products, such as aviation and automotive gasoline, are dyed to permit a rapid visual determination of product and grade. Visually detectable changes in color intensity or hue may be an indication of product contamination or deterioration.

Commingling - mixture of two or more petroleum products normally attributed to improper handling.

Common Servicing - function (achieved through agreement) performed by one Service in support of another for which reimbursement is not required from the Service receiving the support.

Composite Sample - a sample that is a mixture of samples taken from the upper, middle, and lower thirds of a container.

Conductivity - test that measures the electrical conductance of the fuel in picosiemens per meter, normally referred to as conductivity units. The higher the number, the more rapidly the fuel will

dissipate any electrical charge within the fuel. Conductivity additive raises this number to a point where the fuel is unlikely to accumulate electrical charges strong enough to cause sparks and subsequent ignition.

Conductivity Additive - fuel additive that aids in relaxing static charges in fuel by increasing conductivity.

Distribution Plan - a summary of contract award data prepared and published by DESC to advise CONUS and overseas fuel regions and other petroleum management activities of how requirements of a procurement program and delivery period will be supported.

Downgrading - the procedure by which a product is approved for use as a lower grade of the same or similar product, usually performed as a result of contamination or an off-specification condition.

Drum - a 16- or 18-gauge steel cylinder container (generally, 55-gallon size) for petroleum products, often erroneously referred to as a barrel.

Drum Thief - a metal or plastic tube used to withdraw samples from drums.

Emergency Fuel - per TO 42B1-1-14, a fuel which may cause significant damage to the engine or other systems; therefore, its use shall be limited to one flight. The applicable aircraft flight manual or system manager should be consulted regarding operating restrictions and post-flight maintenance actions necessary when using an emergency fuel. Examples of conditions that might warrant use of emergency fuels are: accomplishing an important military mission; countering enemy actions;

emergency evacuation flights; emergency aerial refueling.

Explosive Limits - the limits of percentage composition of mixtures of gases and air within which an explosion takes place when the mixture is ignited. The lower limit of flammability corresponds to the minimum amount of combustible gas and the upper limit to the maximum amount of combustible gas capable of conferring flammability on the mixture. Also referred to as flammable limits and explosive range.

FARE - forward air refueling equipment.

Fire Point - the lowest temperature at which, under specified conditions in a standardized apparatus, a petroleum product vaporizes rapidly enough to form an air-vapor mixture above its surface that burns continuously when ignited by a small flame.

Flammable - a term describing any combustible material that can be ignited easily and which will burn rapidly. Petroleum products that have flash-points of 37.8° C (100° F) or lower are classified as flammable.

Flash point - the lowest temperature at which vapors rising from a petroleum product will ignite momentarily on application of a flame under specified conditions.

Forward Area Refueling and Rearming Point (FARRP) - an operation used to hot refuel aircraft in areas where fuel is otherwise not available. Fuel is transferred from a source aircraft's (C-130, C-141, C-17, or C-5) internal tanks to receiver aircraft while both aircraft engines are running, typically at remote locations under blackout conditions.

Fuels Mobility Support Equipment (FMSE) - air-transportable, fuels-handling equipment (excluding refueling vehicles) used to receive and issue fuel at bare-base locations and to augment locations with fixed-fuel facilities. Examples include air-transportable hydrant systems (R-14s), bulk pumps (R-22s), and filter separators (FFU-15s).

Fuel System Icing Inhibitor (FSII) - an agent (diethylene glycol monomethyl ether) used as an anti-icing additive for jet turbine engine fuels.

GPH - gallons per hour.

gpm - gallons per minute.

Ground Products - those refined petroleum products normally intended for use in administrative, combat, and tactical vehicles; materiel-handling equipment; special purpose vehicles; and stationary power and heating equipment. Products include motor gasoline, diesel fuels (except DFM/F76), fuel oils, kerosene, and ground equipment-lubricating oils.

Harvest Bare - a nickname for an air-transportable package of hard-wall shelters and equipment designed to support Air Force operational squadrons and personnel under bare-base conditions. The package includes housekeeping, aircraft maintenance, and some vehicular support. Harvest Bare is intended to provide a broad base of logistics support for sustained Air Force operations.

Harvest Eagle - a nickname for an air-transportable package of housekeeping equipment, spare parts, and supplies required for support of Air Force general-purpose forces and personnel under bare-

base conditions. Each kit is designed to provide soft-wall housekeeping support for 1,l00 persons. Harvest Eagle is not intended to be an all-inclusive package of logistics support for sustained air operations; however, it may be used until augmented by Harvest Bare.

HEMMTS - Army refueling vehicle.

JPTS - thermally stable jet fuel.

Ignition Point - the point on a temperature scale at which a substance may be ignited or produce combustion.

Limiting Factor - a factor or condition that either temporarily or permanently impedes mission accomplishment.

LIN - liquid nitrogen.

LOX - liquid oxygen.

MIKE (M) - Single letter abbreviation used to designate units in thousands; for example, 100,000 barrels may be referred to as 100M barrels or 100 MIKE barrels.

Naptha - a general term applied to refined, partly refined, and unrefined petroleum products and liquid products derived from natural gas that distill mainly between 175° C (347°F) and 237.8°C (462°F).

Operation Plan - a plan for a single or series of connected operations to be carried out simultaneously or in succession. It is usually based upon stated assumptions and is the form of directive employed by higher authority to permit subordinate commanders to prepare supporting plans and orders.

Outsized Cargo - a single item that exceeds the dimensions of 810 x 117 x 105 inches but is less than 1,453 x 216 x 114 inches.

Oversized Cargo - a single item that exceeds the usable dimensions of a 463L pallet (104 inches by 84 inches) and a height established by the cargo envelope of the particular model aircraft (96 inches for military aircraft and 48 inches for Civil Reserve Air Fleet) but not to exceed 810 x 117 x 105 inches.

Packaged Fuel - those bulk petroleum fuels which, because of operational necessity, are packaged and supplied in containers of 5- to 55-gallon capacity. Fuels in military collapsible containers of 500-gallon capacity or less are also included in this category.

Pipeline Time Quantity - that quantity calculated by multiplying the daily demand rate by the amount of time, in days, required to deliver products from source to terminal, including discharge and settling times as applicable.

POL - petroleum, oils, and lubricants. Also, refers to all products handled by Air Force fuels management personnel including LOX, demineralized water (DW).

Prepositioned War Reserve Materiel Requirement - the portion of the WRM requirement that current Secretary of Defense guidance dictates be reserved and positioned at or near the point of planned use prior to hostilities; intended to reduce reaction time and ensure timely support of a specific force or project until replenishment can be effected.

Prepositioned WRM Stock - assets designed to satisfy the prepositioned WRM requirement.

Primary Fuel - per TO 42B1-1-14, the fuel or fuels used during aircraft tests to demonstrate system performance (contract compliance) through the complete operating range for any steady state and transient operating condition.

Peacetime Operating Stock - logistics resources on hand or on order necessary to support day-to-day operational requirements; can also be used to offset sustaining combat requirements.

Primary Stockage Objective - the maximum quantity of materiel authorized to be on hand to sustain current operations. It consists of the safety level quantity and the economic resupply quantity.

REPOL - petroleum damage deficiency report.

Shell Capacity - the gross volume of a petroleum storage tank as determined from tank calibration. The term is synonymous with rated storage capacity.

Short Ton - unit of weight equal to 2,000 pounds.

Sortie rate - rate at which assigned aircraft are scheduled to fly. Example, if a squadron of 18 aircraft were expected to achieve a 1.5 sortie rate, it would have to fly a total of 27 missions (1.5 times 18) in 1 day.

Source Identification and Ordering Authorization (SIOATH) Form - a form listing contractor supply sources and effective prices and quantities for authorized activities to order or

requisition. It also advises the ordering activities of the supply data necessary to schedule a product and place an order.

Special Experience Identifier (SEI) - a three-digit number used to identify personnel with special training or skills. SEIs in fuels are FARRP-035, cryotainer maintenance-036, cryo production-037, Laboratory-039, Accounting-040, ABFDS-369, and ATHRS-387.

Specific Gravity - the ratio of the weight of a given volume of the material at 60° F to the weight of an equal volume of distilled water at the same temperature, both weights being corrected for buoyancy of air.

Surfactant - a substance capable of reducing

Water, Entrained - free water that is suspended throughout a fuel sample and has not settled to the bottom of the container. This water is normally separated from the fuel by ground-servicing equipment filter separators.

Water, Free - all water present in fuel that has not been dissolved in the fuel. This water is normally separated from the fuel by ground-servicing equipment filter separators.

Water Separation Index Modified (WSIM) - measures the water separation characteristics of fuels. This test reflects the ease with which fuel releases dispersed or emulsified water. Surfactants have an adverse effect on the WSIM rating. Fuels having low WSIM ratings will poison filter separators and prevent them from functioning properly.

Fuels Airfield Site Survey

The following is a sample guide of the kind of information a fuels person needs to determine fuel support capability at a deployed location. The survey is not all-inclusive but provides a good foundation to build from. This survey is broken out by work area, but a deployed environment may not be configured in this manner.

Bulk Storage

- What products will be store? Where will they be stored, on or off base?
- How many tanks are available, and what is the storage capacity? What are minimum and maximum inventory levels?
- How many fillstands are there, and what is their pumping capacity? Are they top or bottom loader types?
- How far are fillstands from the refueling area?. Are they equipped with meters?
- How is product resupplied, what is the resupply capability, and are special adapters needed?
- How many receipt headers exist; where are they located?
- How many trucks can offload simultaneously?
- What is the total per-hour receiving rate using all methods of receipt for each grade of product (in gallons); can fuel be resupplied year round?
- Are LOX, LIN, DW, ground fuels, or deicing fluid available? If not, where can they be obtained, and what is their resupply rate?
- How are ground fuels resupplied?

- Does a fuel service station exist? Where is it located? What products are stored and dispensed?
- Are bulk storage tanks dedicated to sole USAF, joint service, or combined operations use?
- Do earthen or sandbagged dikes exist for fuel bladder placement?
- Does FMSE positioning facilitate combat quick turns?
- Are available personnel trained to assemble FMSE systems?
- Is backup power available for fuels systems?
- Who is designated to maintain the system?

Hydrant Systems

- What types of hydrant systems are available: fixed, portable, and what is their condition?
- What is the storage capacity?
- What is the receipt capability; can the system receive directly from commercial source?
- How many outlets are available?
- What is the refueling capacity of the system?
- How many aircraft can be serviced simultaneously; what is the flow rate?
- Can large aircraft (C-5, B-52, C-17) be parked on outlets? Can they taxi on and off, or do they have to be towed?
- Are outlets far enough apart to permit simultaneous parking of more than one large aircraft on the same lateral?
- How many fillstands are available; what is their location and pumping capacity?
- How many and where are the offloading headers located for defueling?

- How many hosecarts are available? What is their condition? Are special adapters needed?
- Who will maintain the system and equipment?
- Is emergency power available?

Refueling Equipment

- How many refueling units are available? What is their condition?
- Who will maintain refuelers?
- How many general-purpose vehicles are designated for POL?
- What type of communication is available; for example, number of phones, hot lines, mobile radios? Is computer connectivity available?
- Where will the fuels information service center be located? (building and phone number)
- Does facility have backup power?
- Are WRM units designated for the deployed location; when will they arrive?
- What security measures are available for the compound?
- Where will refueler parking area be located?
- What is the average turnaround time for refueling from full on the line to the fillstand and back?

POL Laboratory

- Is a fuels lab available at the host site? If not, where will the lab be located?
- Is the host lab equipped, supplied, and manned with trained technicians to perform necessary analysis?
- Where and how far (distance and travel time) is the nearest commercial or area laboratory?

Fuels Personnel

- What is the host base, fuels personnel strength?
- How many are designated to arrive?
- Are provisions ready, such as quarters, latrines, and meals?
- Will additional fuels personnel be required due to increased flying?
- Are there sufficient numbers of SEI-qualified people to man lab, accounting, cryogenics, and FMSE functions?
- Identify any limiting factors or shortfalls that would adversely impact the mission of the deployed unit.

References and Supporting Information

AFI 23-201, *Fuels Management*

AFI 23-221, *Fuels Logistics Planning*

AFOSH 91-38, *Hydrocarbon Fuels, General*

DoD M 4140.25, *Management of Petroleum Products*

MIL-HDBK-114, *Mobility Fuels User Handbook*

MIL-HDBK-200, *Quality Surveillance*

MIL-HDBK-201, *Petroleum Operations*

MIL-HDBK-210, *Conversion Factors for Petroleum*

MIL-HDBK-318, *Cargo Aircraft Compartment Dimensions*

TO 00-25-172, *Ground Servicing of Aircraft*

TO 35E13-73-11, *PMU-27*

TO 37-1-1, *Operation, Inspection of Permanent Fuel Systems*

TO 37A-1-101, *Fuel/Water Dispensing Equipment*

TO 37A9-3-5-1, *A/E32R-14 Fuel System*

TO 37A9-3-7-1, *C-130 ABFDS*

TO 37A9-3-8-11, *A/M32R-25 Fuel System*

TO 37A9-3-11-1, *GRU-17/E*

TO 37A12-15-1, *10K/50K Bladders*

TO 37C2-8-10-3, *400 Gal LOX Tank Type TMU-24E*

TO 42B-1-1, *Quality Control*

Air Force Logistics Management Agency

Since its inception, the Air Force Logistics Management Agency has grown to be recognized for its excellence—excellence in providing answers to the toughest logistics problems. And that's our focus today—tackling and solving the toughest logistics problems and questions facing the Air Force. It's also our focus for the future.

Lots of organizations have catchy mottoes. Likewise, many have catchy vision statements. We do, too. But there's a big difference—we deliver on what we promise. Generating Solutions Today, Shaping Tomorrow's Logistics aren't just words to us; they're our organizational culture. We use a broad range of functional, analytical, and scientific expertise to produce innovative solutions to problems and design new or improved concepts, methods, systems, or policies that improve peacetime readiness and build war-winning logistics capabilities.

Our key strength is our people. They're all professionals from logistics functions, operational analysis sections, and computer programming shops. Virtually all of them have advanced degrees, some of which are doctorates. But more important, virtually all of them have recent field experience. They've been there and done that. They have the kind of experience that lets us blend innovation and new technology with real-world common sense and moxie. It's also the kind of training and experience you won't find with our competitors. Our special blend of problem-solving capabilities is available to every logistician in the Air Force.

Notes

Notes

Notes

Notes

Notes

Notes

The Unsung Heroes of the Flightline

Most people don't care, nor realize, as well
about the job done by base POL.
To the pilots and crews, refueling's a bore
and the reason I feel, is they don't know the score.

From drawing board to production line,
it takes large appropriations
to build a great aircraft, and get it on station.
And lost in the shuffle, at least seems the rule,
is the need for this "bird" to be fed good clean fuel.

The engine men settle for no less than perfection
and the radar men strive for much finer detection
but exposed to the corrections of every known tool
the aircraft goes nowhere without the right fuel

But POL's job can be very complex,
from receiving at bulk to their quality checks.
They, too, tune equipment with no element of guess,
to ensure that pumps hum and filters coalesce.

They check each sample by chemical test,
and their quality control plan is always the best.
From lead acetate paper to isometric titration
the fuel runs the gamut to meet specification.

The process seems simple: You place a call
to the pol dispatcher, who checks the chart on the wall
He sends out a unit in accordance with the order
be it JP, or avgas, or demineralized water.

So the next time you observe an aircraft go off,
full bore down the runway, with nary a cough,
and rise in the air, a most thrilling show,
POL played a big part in making it go.


Without Fuel
POL
Pilots Are Pedestrians

AFLMA

501 Ward Street
Gunter Annex, Maxwell AFB
36114-3236
http://www.il.hq.af.mil/aflma/index.shtml